

Tank 16 Annulus Cleaning



Engineering Technology Development

Quy L. Nguyen
Process Development Engineering
Dennis J. Clark
Design Authority Engineering

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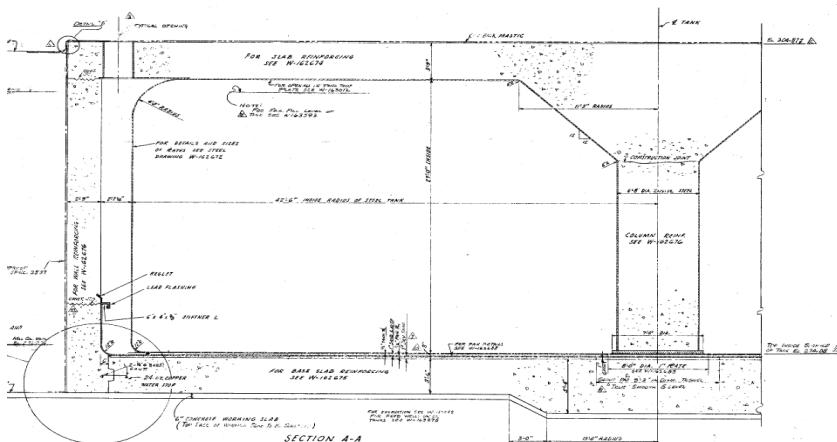
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Project Objective

To identify and demonstrate technology capable of dislodging and removing waste from the Tank 16 annulus

Tank 16 Waste Tank

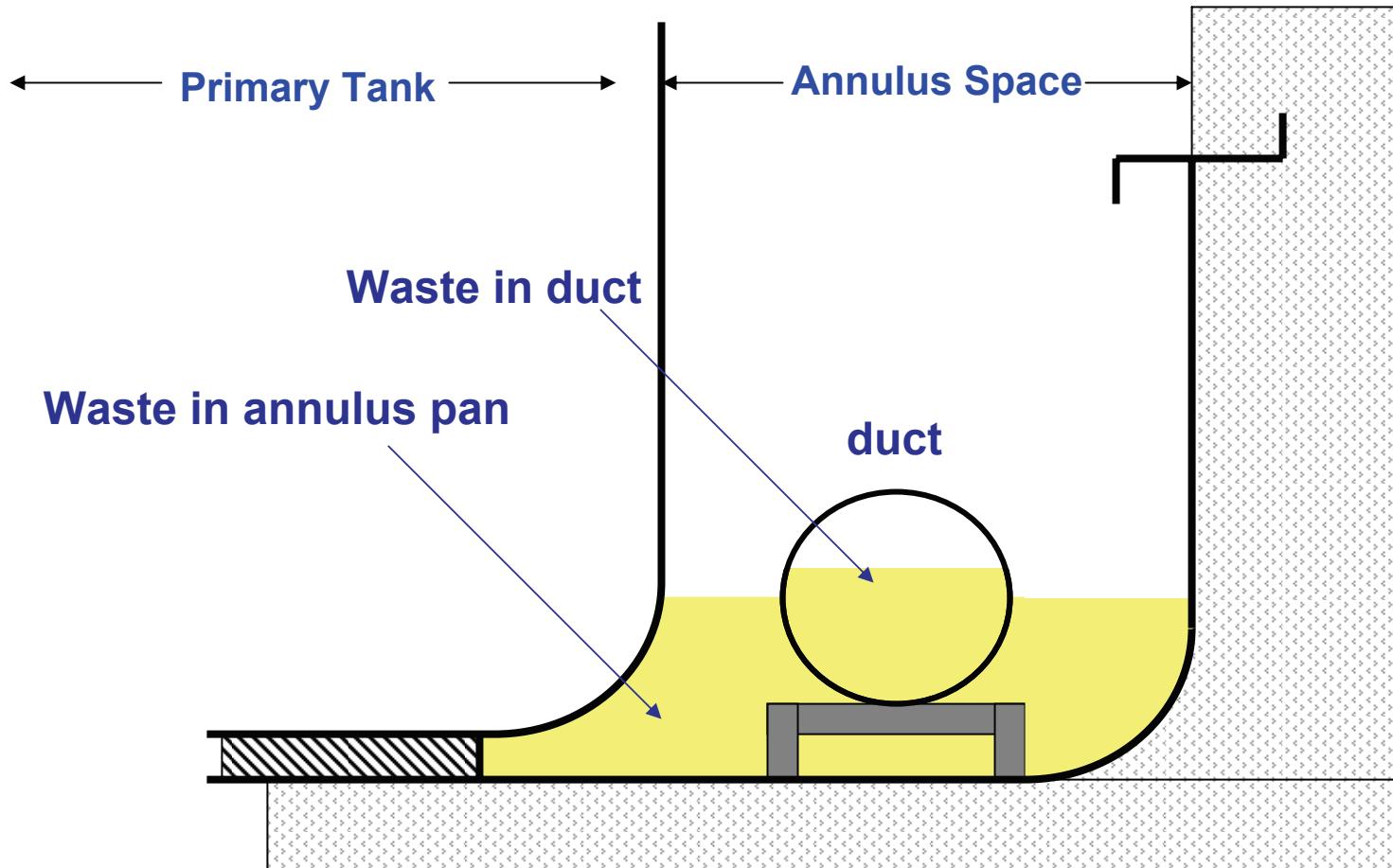


- **1.1 million gallon capacity**
- **Primary tank with an annulus space**
- **Primary tank is 85' in dia., 27' high with a 3'-9" top slab and is center supported**
- **Annulus space is 2'-6" wide with a ventilation duct at the bottom**
- **Ventilation duct's diameter ranges from 20" down to 12"**
- **Both primary tank & annulus have multiple entry points**

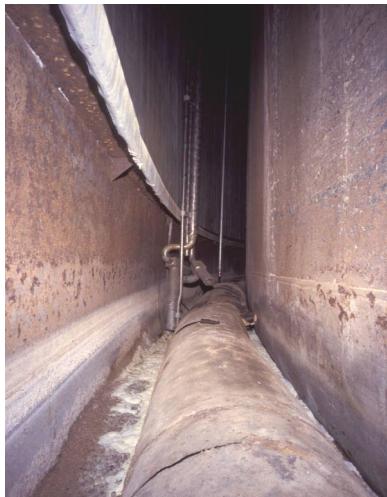
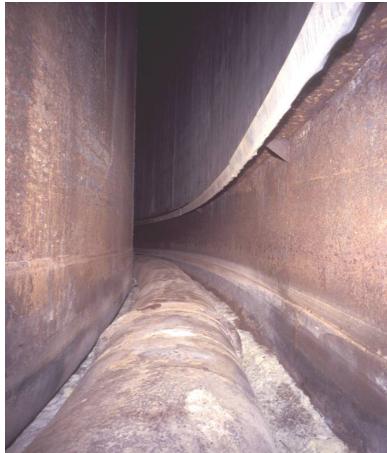
Tank 16 History

- Primary Tank
 - Placed in service in May 1959
 - Leaks detected in annulus in November 1959
 - Removed from active service in March 1972
 - Oxalic acid cleaned in 1979-1980
- Tank Annulus
 - Waste overflowed annulus pan in September 1960
 - Tank wall sandblasted for NDT inspection and several tank wall sample coupons were cut out to evaluate failure mechanism
 - Cracks caused by Sodium Nitrate Stress Corrosion (more than 350 leak sites identified)
 - Annulus cleaning performed in 1982 by circulation of heated inhibited water and steam jet transfers
 - Initial annulus sampled in 1995, material identified to be crusty, insoluble “natrodavyne” and sand
 - Recent annulus samples taken both inside and outside the duct from Risers IP-118 and IP 35 contained significant amount of soluble waste (~ 50 vol%)

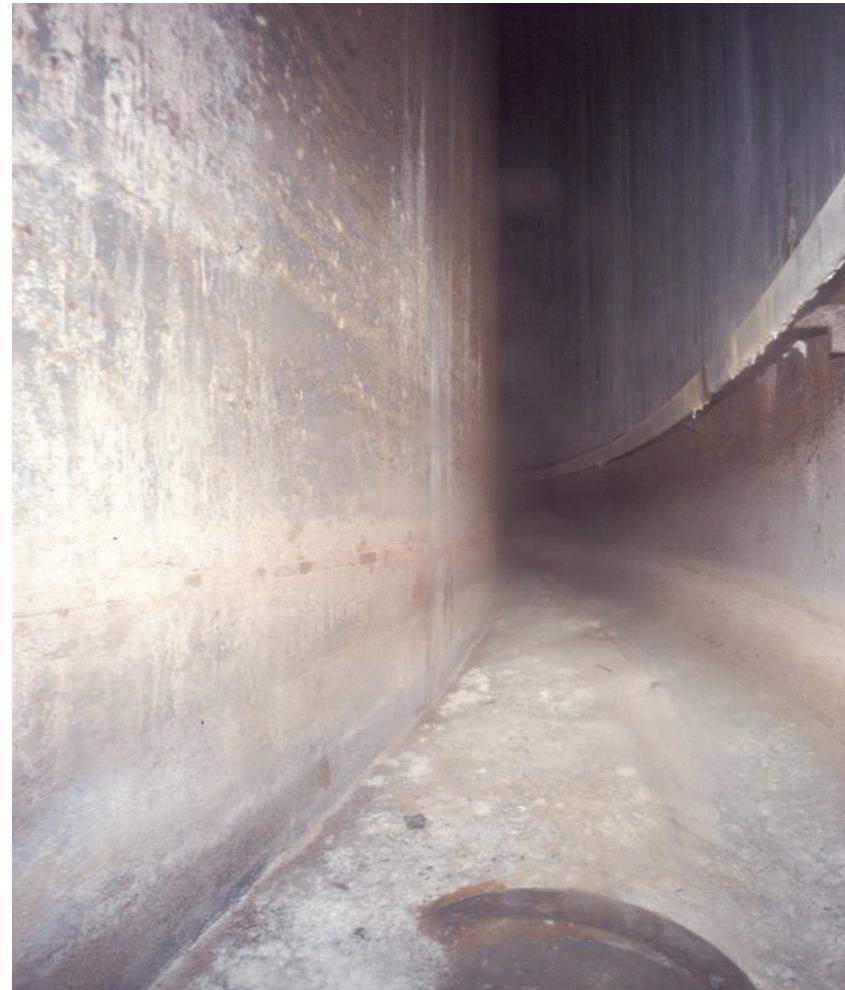
Annulus Section



Tank 16 Interior View of the Annulus



Tank 16 Interior View of the Annulus



Project Scope

- **Vendor Selection**
 - Identify Vendor(s) to Perform Tank 16 Annulus Cleaning
- **Phase I**
 - In shop Demo (Proof of Concept)
- **Phase II**
 - In Tank Demo (1 quadrant)
- **Phase III**
 - Clean Remaining Annulus

Technical Risks

- **Unable to remove material**
 - Vendor demonstration with bounding simulant
 - SRNL provided independent conceptual backup plan
- **Unable to reach all areas**
 - Vendor shop demonstration to perform extent of reach, travel
 - Multiple tools to cut, remove obstructions
- **Impacts tank or annulus**
 - Restricted technology to minimal water usage
 - Tank top loading limits in SOW
 - Safety Basis review of vendor technology
- **Material unable to be moved forward in HLW system**
 - Size reduce material to ensure ability to resuspend
 - Prohibited use of incompatible materials

Technology Selection Criteria

- Remove solid, hard material
- Remove material from all areas
- Remote operation within annulus
- Reach entire annulus from specified access points
- No structural impact
- Minimize water usage in cleaning & transfer
- Size reduction capability
- No impactful materials used
- Low impact to facility operations

Technology Selection Strategy

Initial Vendor Identification	Expression of Interest to 46 Vendors	Request for Proposal to 8 Vendors
• Tank Cleaning Technical Exchange	• Identify Strongest Potential	• SOW with 3 Phases: - Phase I: In-shop Demo (Proof of Concept)
• Goldfire Innovator	• Eliminate Duplicate Technology	- Phase II: In-tank Demo (1 quadrant)
• Thomas Register	• Emphasize Teaming	- Phase III: Cleaning Remaining of Annulus
• Known Experience	• 14 Teams Responded	• Budget Placeholder Estimates for Rad Demo & Final Cleaning
➤ 46 Candidate Vendors Identified	➤ 8 Vendors Selected	➤ 3 Vendors Submitted Proposals

SRNL engaged to provide independent conceptual backup plan

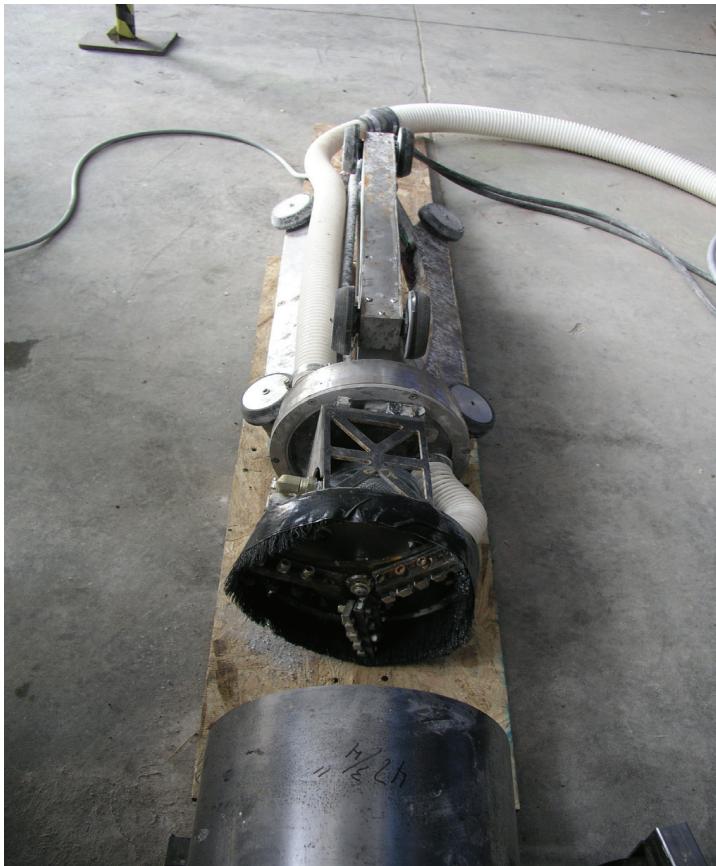
- Awarded Phase I contract to SEC on 2/21/07
- Vendor conducted Phase I Demonstration on 5/22-23 at S. A. Robotics in Loveland, CO, with WSRC team present

Tank 16 Phase I Demo Facility



Demo Proof of Concept

Pipe Crawler with Scarifying Head



Demo Proof of Concept



Pipe Crawler with Cutting Head



Arm with Cutting Head

Demo Proof of Concept



Two Types of Scarifying Heads



Demo Proof of Concept



Final Results of the Phase I Demo



Tool Demonstration Results

Tool	Demonstration	Results
Arm Cutting Head	Cut access opening in 16 gauge duct using remote cutting head	Successful; equip. functioned as designed. Some concern about duct section not detaching completely & sharp edges left behind
Arm Scarifying Head	To remove bulk of simulant from bottom of Tank 16 mockup	Successful; some scarifying was done with initial design but there were major concerns regarding removal rate. Head was modified after the demo and achieved much greater removal rate.
Arm Wire Brush Head	Perform detailed waste removal.	Successful; wire brush performed as designed. No significant dust created.

Tool Demonstration Results

Tool	Demonstration	Results
Arm Chipping Hammer Head	To perform waste removal in difficult to access areas.	Successful; dome chipping was performed using 16 point bushing tool. Tool was found to be a great for bulk removal tool.
Pipe Crawler – Scarifying Head	Remove simulant located inside duct	Marginal success with some concerns regarding removal rates. Simplified pipe crawler functioned as designed but wore through unhardened cutting teeth rapidly.
Pipe Crawler – Cutting Head	Size reduce duct	Marginal success, concerns about cutting speed and wear on cutting head.

Review of Phase I Demonstration

- **Demonstration successes**
 - Aerosolization minimization
 - Capable of reaching annulus bottom
 - Material size reduction capability
 - Dry waste transport – 3” dia. x 200’ run/rise/fall
 - Arm, ability to change out to different end effectors
 - Strong technical approach to solve emerging engineering challenges

Review of Demonstration

- **Improvement Areas**
 - Arm needs more degrees of freedom
 - Vacuum system needs to be sized correctly
 - Longevity of tools
 - Pipe crawler was not effective in both cutting the duct and waste removal operation as well as cable management
 - Tools change-out time needs to be reduced to minimize personnel exposure

Conclusions

- **Successfully completed Phase I Demonstration**
- **Identified areas for improvement in Phase II**
- **Phase II is Pending**
 - Non-labor funding shortfall

Questions?

Contact Information

- **Dennis J. Clark**

Phone: (803) 208-2898

Email: dennis.clark@srs.gov

- **Quy L. Nguyen**

Phone: (803) 208-8682

Email: quy.nguyen@srs.gov